

In Situ HAB Monitoring of the FDEP Gulf dispersal of Piney Point treated waste water
Report covering the September 3 to 5, 2003 monitoring cruise
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Introduction

Monitoring for Harmful Algal Blooms (HAB) during the dispersal of treated Piney Point waste water in the Gulf of Mexico is conducted at approximately biweekly intervals using vessels chartered from the Florida Institute of Oceanography (FIO). The overall objectives of the program are to collect samples that can be used to determine: 1. the presence of HAB species, 2. increases in biomass of phytoplankton populations, and nutrient concentrations. The specific objectives of this component of the HAB monitoring program are 1. to conduct a survey of surface waters along two transects within the dispersal region and provide maps of temperature, salinity, chlorophyll fluorescence, and light transmission; 2. Provide CTD profiles at fourteen locations outside of and within the dispersal area (Fig. 1) and collect surface and mixed layer samples that will be used for the analysis of chlorophyll-a concentration, phytoplankton species counts, and nutrient concentrations. The latter two analyses (counts and nutrients) will be performed by others and reported separately.

Methods

CTD profiles are taken at fourteen stations along two transects that traverse the area where water dispersal occurs (Fig. 1). Stations 1 and 14 are located shoreward of the permitted dispersal zone and should be indicative of West Florida Shelf waters without Piney Point water additions. These two stations should also allow us to estimate if treated water moved shoreward.

During this cruise a Wet-Labs chlorophyll fluorometer was used on the CTD unit rather than the normal Chelsea instrument. The Wet-Labs fluorometer reports a “calibrated” chlorophyll value rather than just voltage as with the Chelsea. Therefore the values for relative chlorophyll fluorescence in this data set are distinctly different (higher) than values reported previously. They should not, however, be interpreted as indicating an increase in chlorophyll concentration.

Surface underway measurements are made along each transect using a Falmouth Scientific MicroCTD3 system coupled to a SeaPoint fluorometer, SeaPoint turbidity meter, and a WetLabs 10cm transmissometer measuring light transmission at 660 nm. The instruments are placed into a darkened vessel through which surface sea water is continuously circulated. Output of the CTD system is merged with GPS Latitude and Longitude and stored for later averaging and plots using Surfer^R software. Underway plots will be forwarded as they become available. We are still awaiting modifications of our software in order to average the data for the plotting routines.

Water samples are collected at three depths (surface, mixed layer, and subsurface chlorophyll maximum) in darkened 250 ml bottles for chlorophyll-a analysis. All samples are filtered through GF/F glass fiber filters on board ship and immediately placed into 100% Methanol before storage at -20°C until extraction and fluorometric analysis in the laboratory following the method described by Holm-Hansen and Reimann (1979).

Data from the CTD profiles are averaged at 1 meter intervals using SeaSoft^R software and plotted with Surfer^R.

Results and Discussion

CTD transects

Individual station plots of all CTD casts taken during this cruise are shown in Appendix 1. The composite salinity profiles show reduced salinity (below 35) at stations 1 to 4 along transect 1 while salinity in the range of 32 to 33 was found at station 3 along transect 1 and stations 12 to 14 along transect 2 (Figs. 2 and 3; Appendix 1). The lowest salinity water was located along the eastern edge of the discharge area. This salinity distribution was confirmed in our underway maps of surface salinity (Appendix 2). The region of reduced salinity is characterized by low chlorophyll fluorescence and slightly elevated temperature which suggests that it is not related to Mississippi River discharge. As seen in Appendix 2, the barge track (yellow dots) indicates that most of the discharge took place to the west of the low salinity area. Unless the low salinity is residual from previous discharges, which is unlikely, then the origin of this lower surface salinity is unknown.

CTD profiles of temperature, salinity and sigma-t indicate the mixed layer varied between 5 and 25m depending upon location (Appendix 1 and Figs. 2 and 3). The variability in depth of the mixed layer may be related to the oscillations seen in the temperature isopleths (Figs 2 and 3). The sigma-t composite for transect 1 suggests upwelling occurred between Sts. 6 and 7 but the isopleths further south along transect 2 do not indicate upwelling. However, a CTD profile was not done at St. 8 because of weather so the upwelling signature may have been missed.

Extracted chlorophyll-a and phaeopigment concentrations (Appendix 3) for surface samples for all locations were <0.3 µg/l and are equivalent to or lower than chlorophyll concentrations measured at the same locations during the Aug. 27 - 29 cruise. These values are within the expected range for this region of the West Florida Shelf. Subsurface chlorophyll maxima (SCM) were once again seen in the CTD fluorescence profiles (Appendix 1) and had relative fluorescence several fold greater than surface values. Depths of the SCM vary from 50m to 70m along both transects with a slightly shallower peak at St. 6 which is along the edge of the observed upwelling.

In vivo chlorophyll fluorescence, as seen in the CTD profiles in Appendix 1, with the exception of Sts. 7 and 13, do not show the near surface peaks in fluorescence noted during the two August cruises. We do not have an explanation for this change.

In summary there is no indication of reduced surface salinity or enhanced chlorophyll concentration in the region of discharge during this monitoring cruise.

Reference

Holm-Hansen, O. and B. Reimann. 1979. Chlorophyll a determinations: Improvements in methodology. OIKOS 30: 438-441.

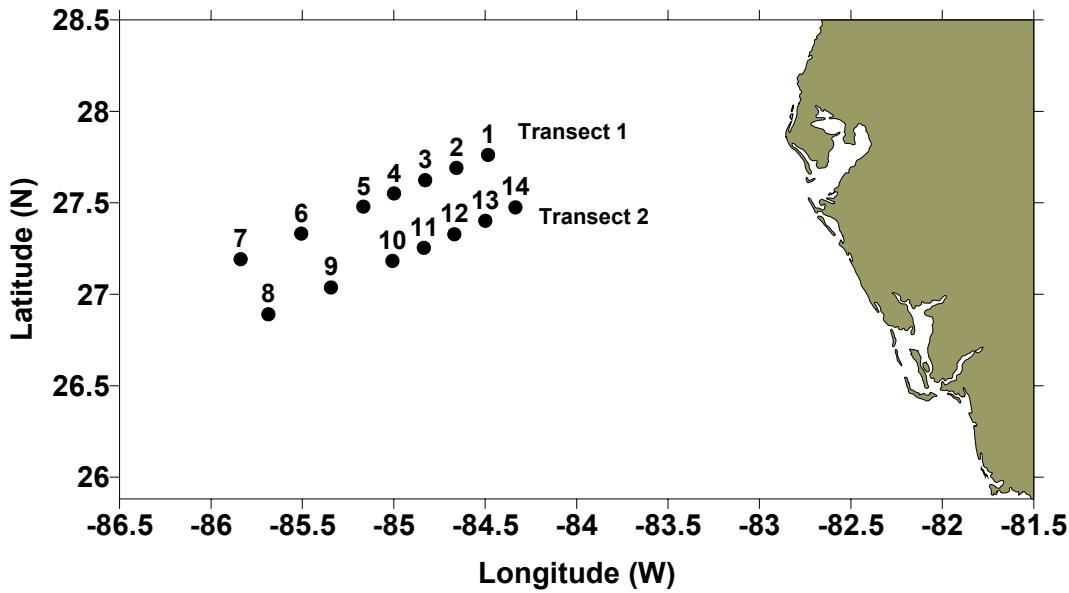


Fig. 1: Location of Stations for CTD profiles and sampling during dispersal of treated water from the Piney Point phosphate plant.

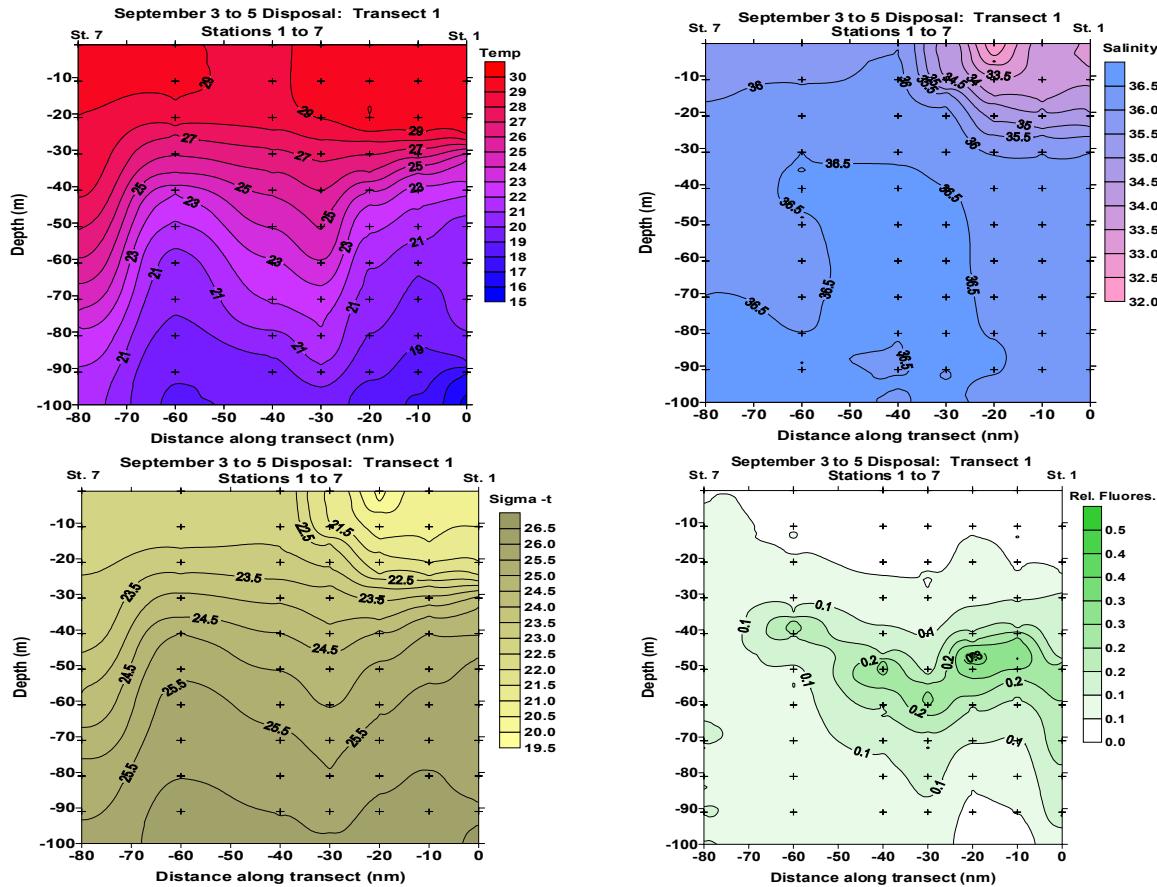


Fig. 2: Composite of CTD profiles along Transect 1

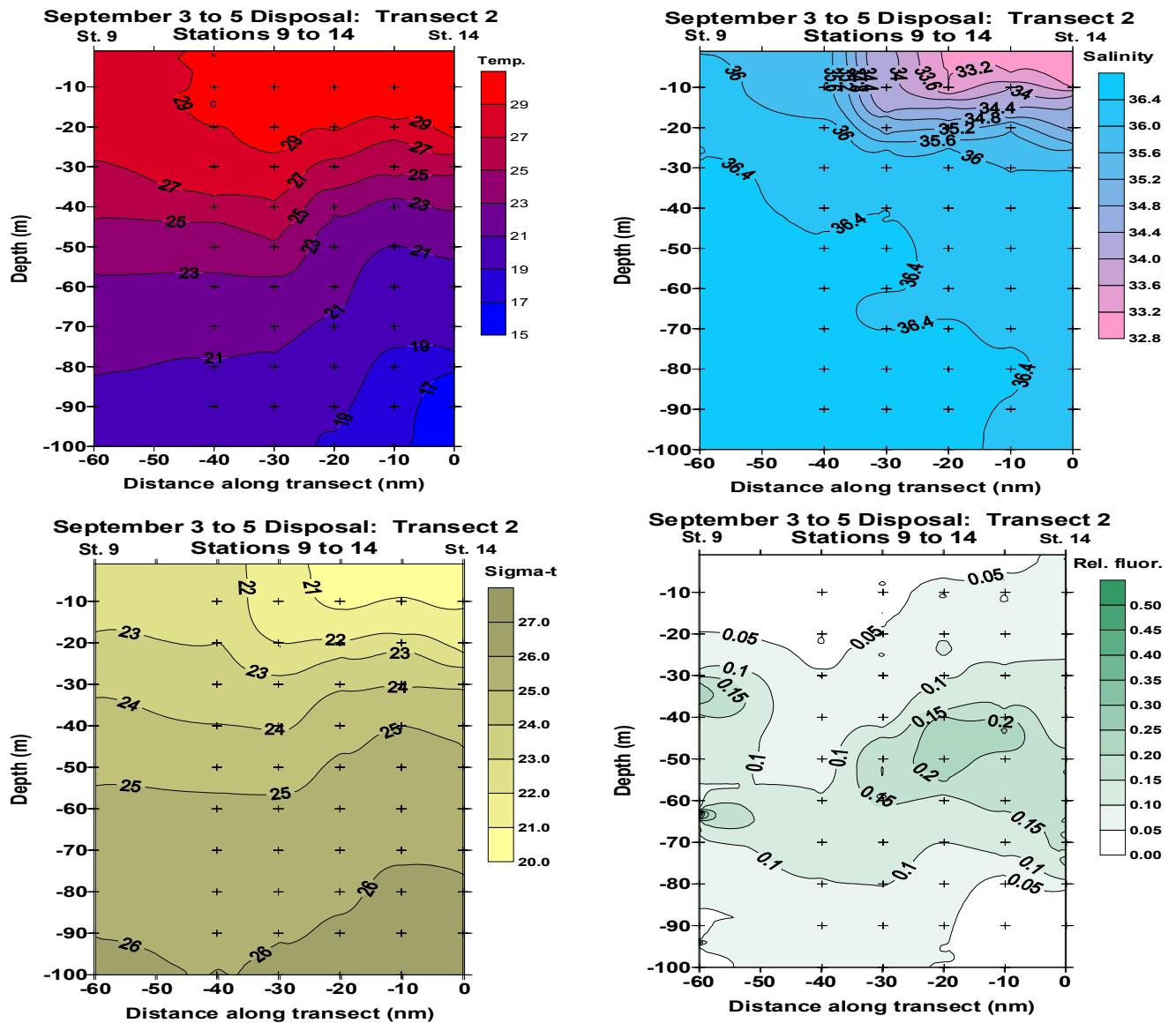
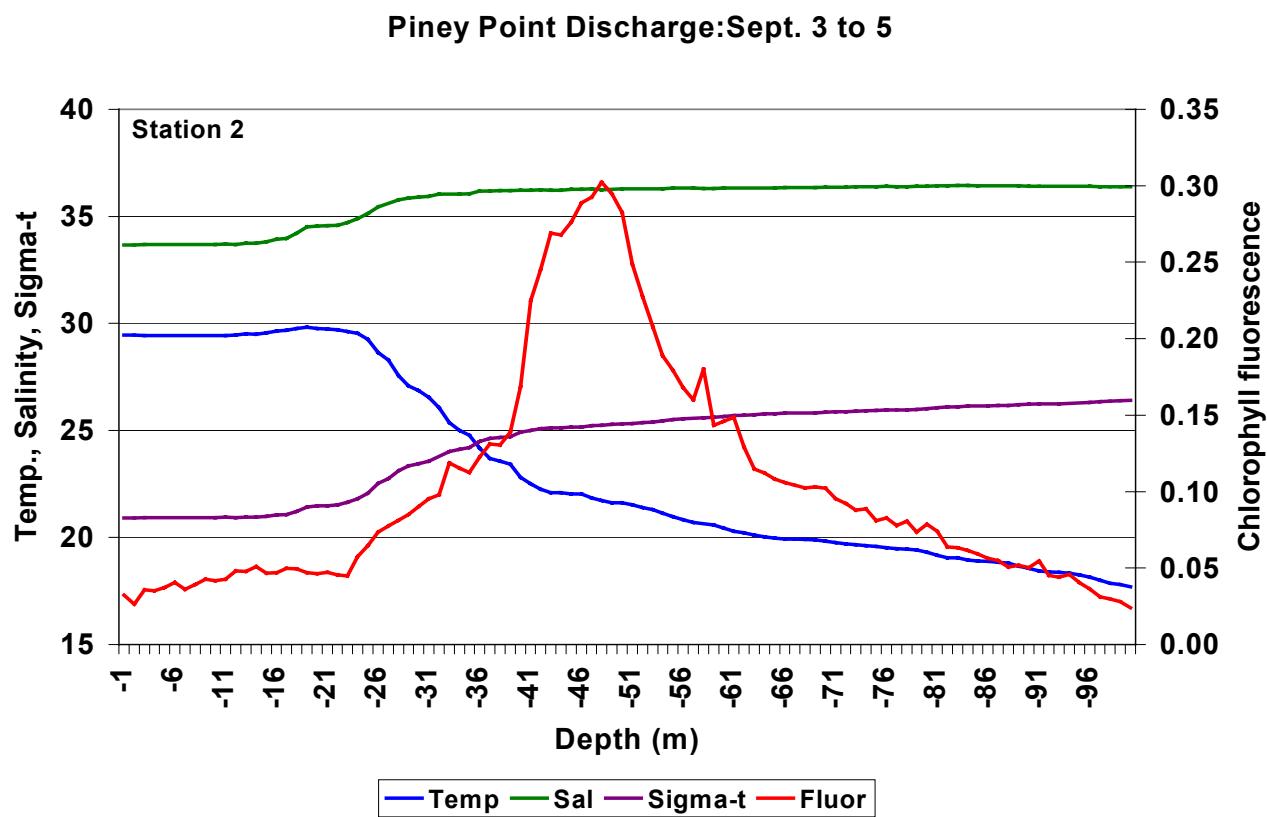
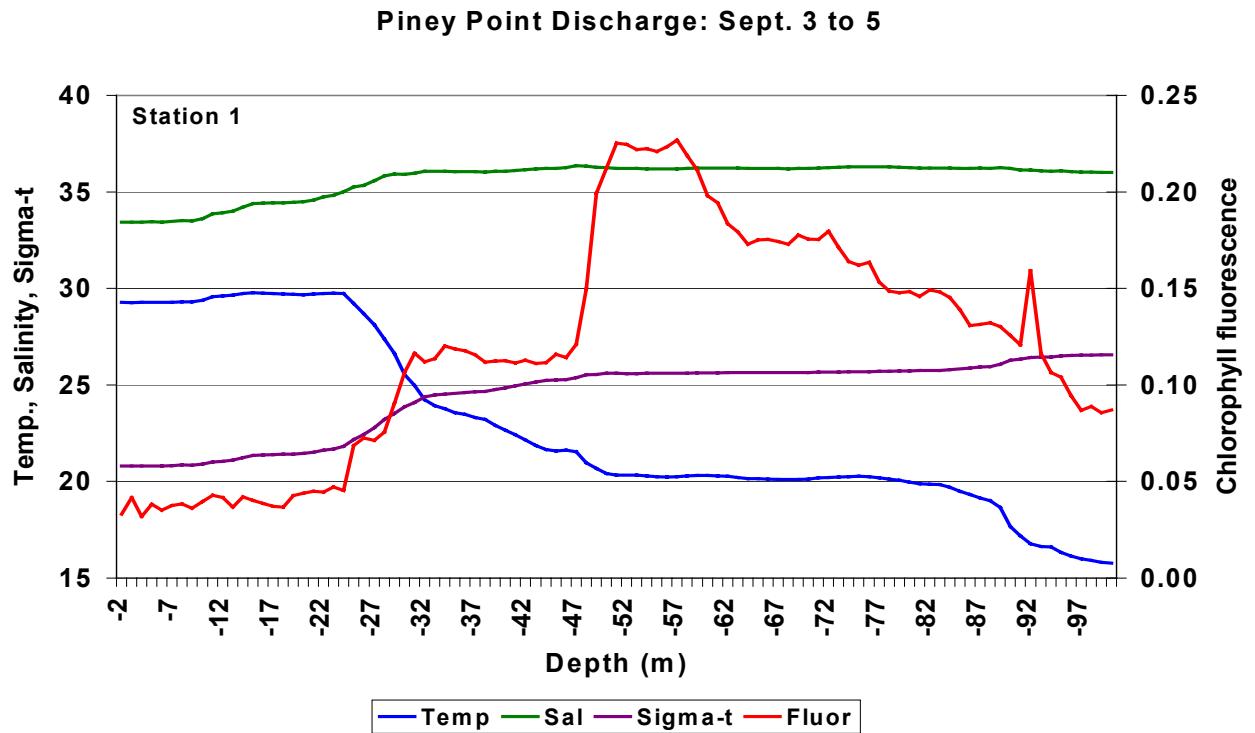
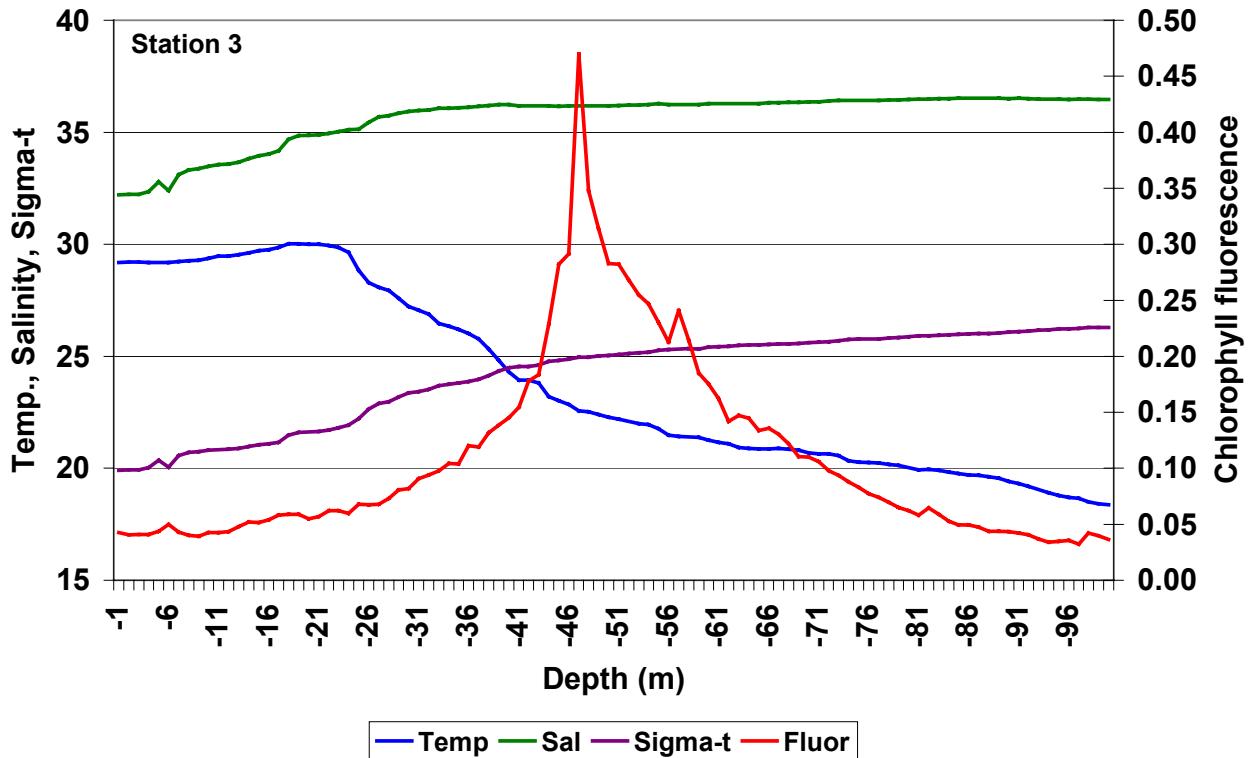


Fig. 3: Composite of CTD profiles along transect 2; Stations 9 to 14.

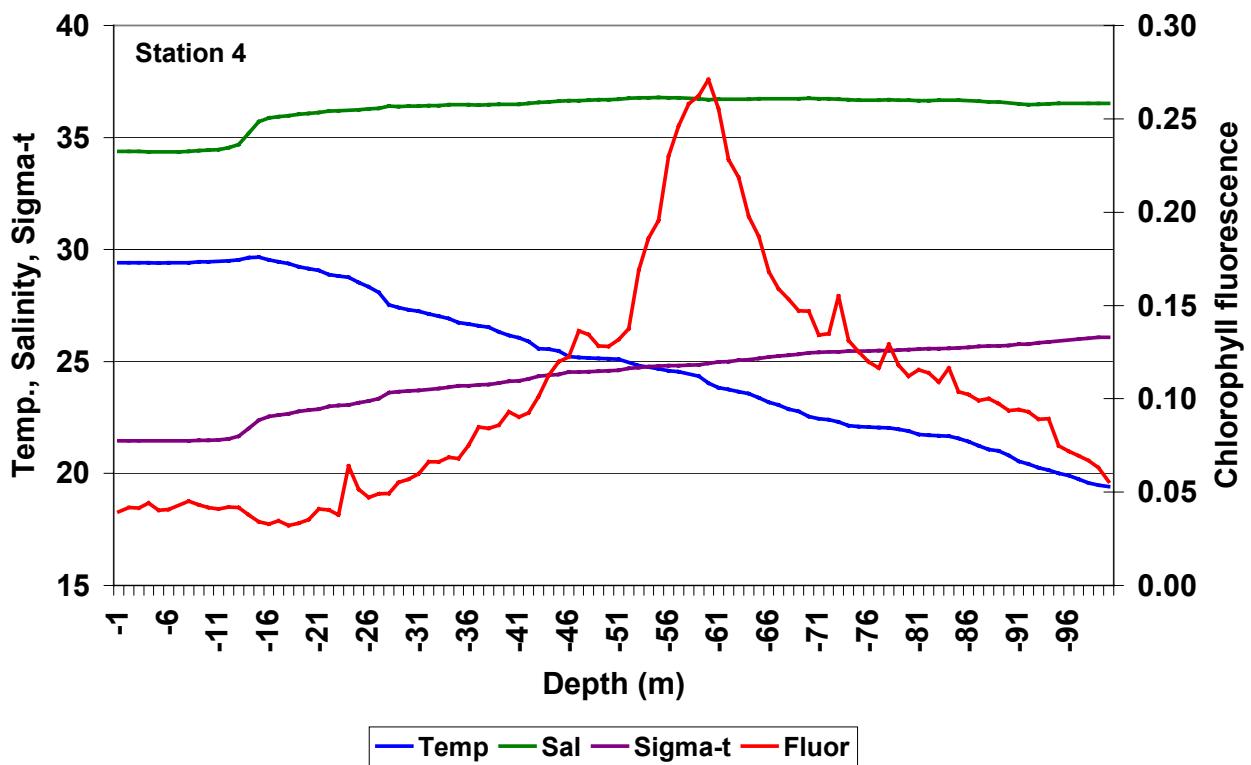
Appendix 1: CTD profiles during the September 3 to 5 monitoring cruise.



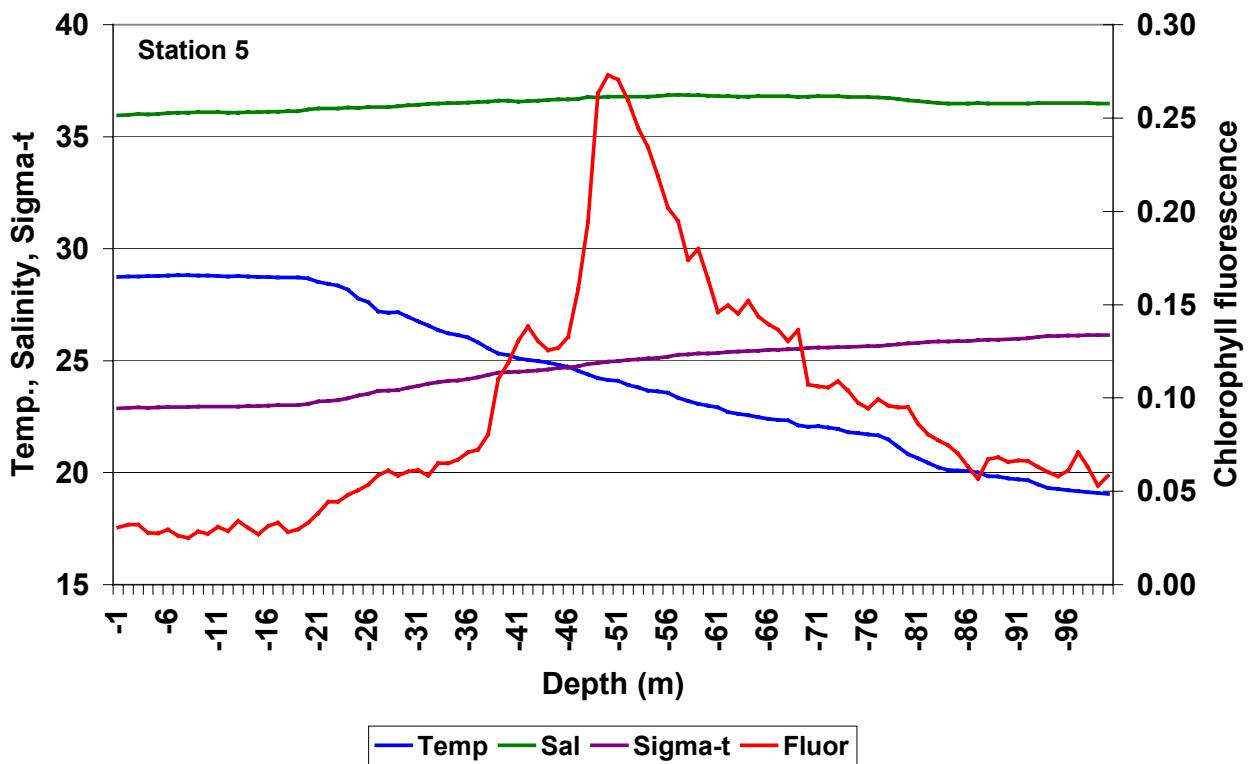
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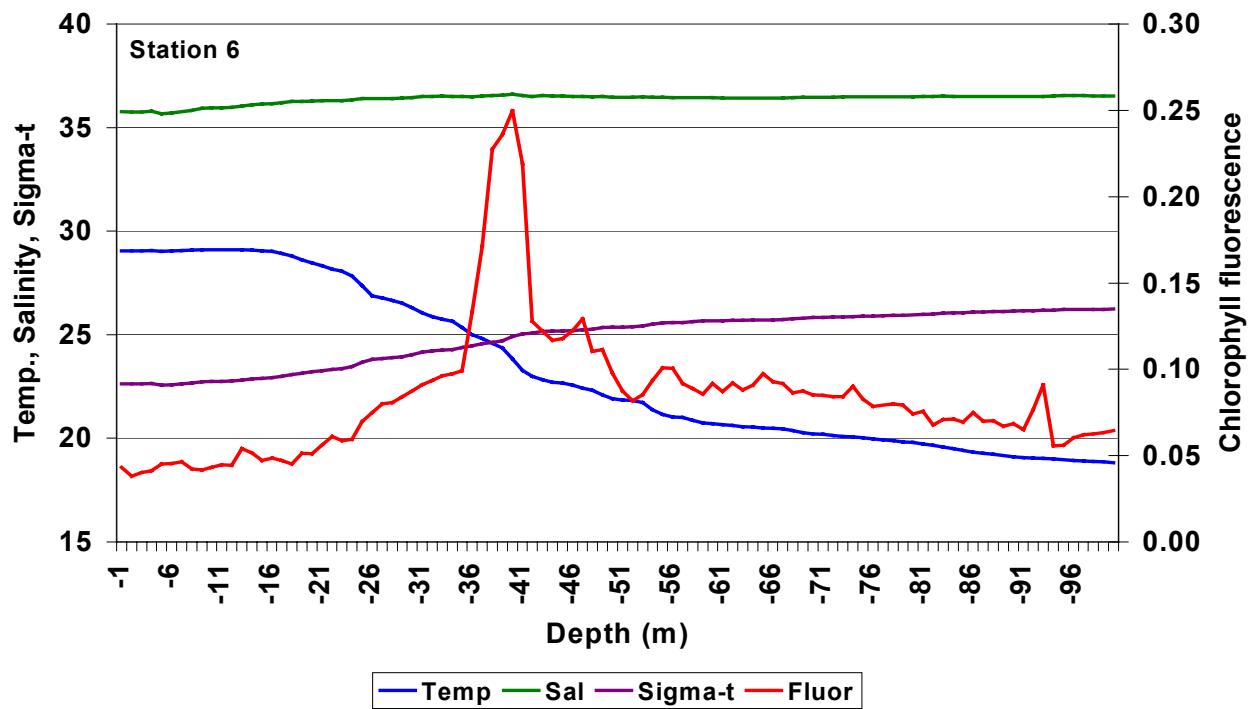
Piney Point Discharge: Sept. 3 to 5



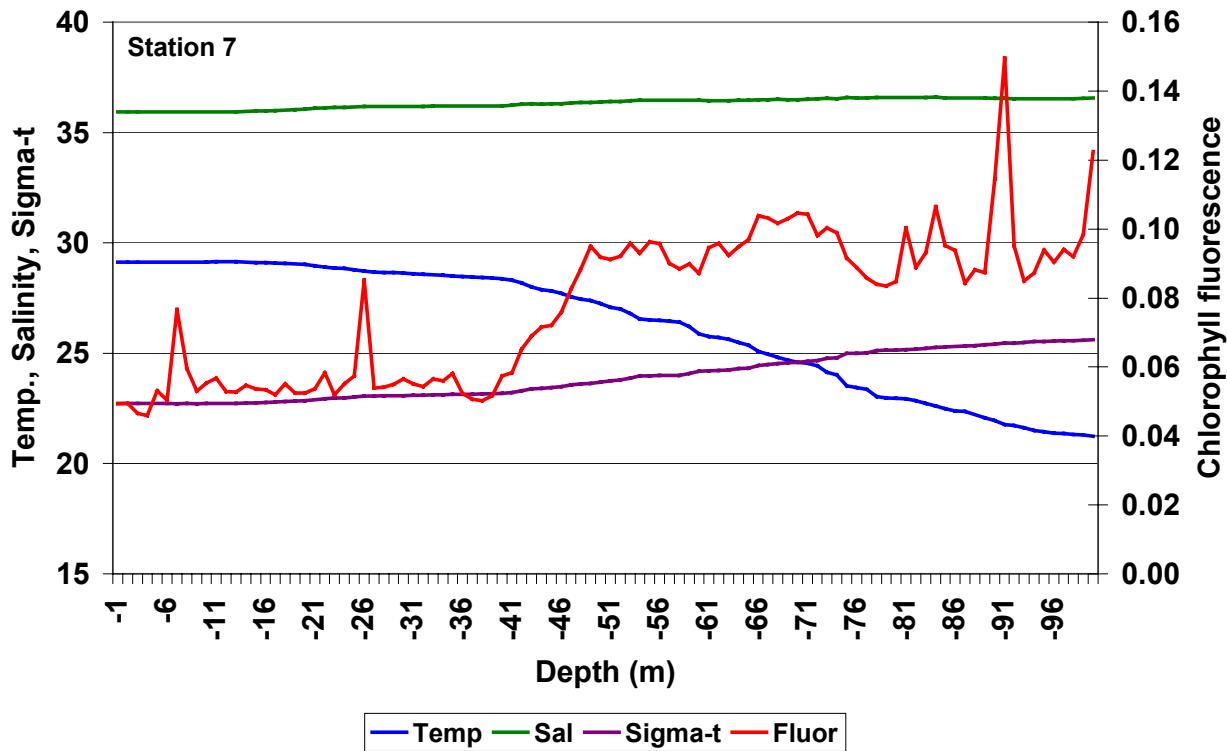
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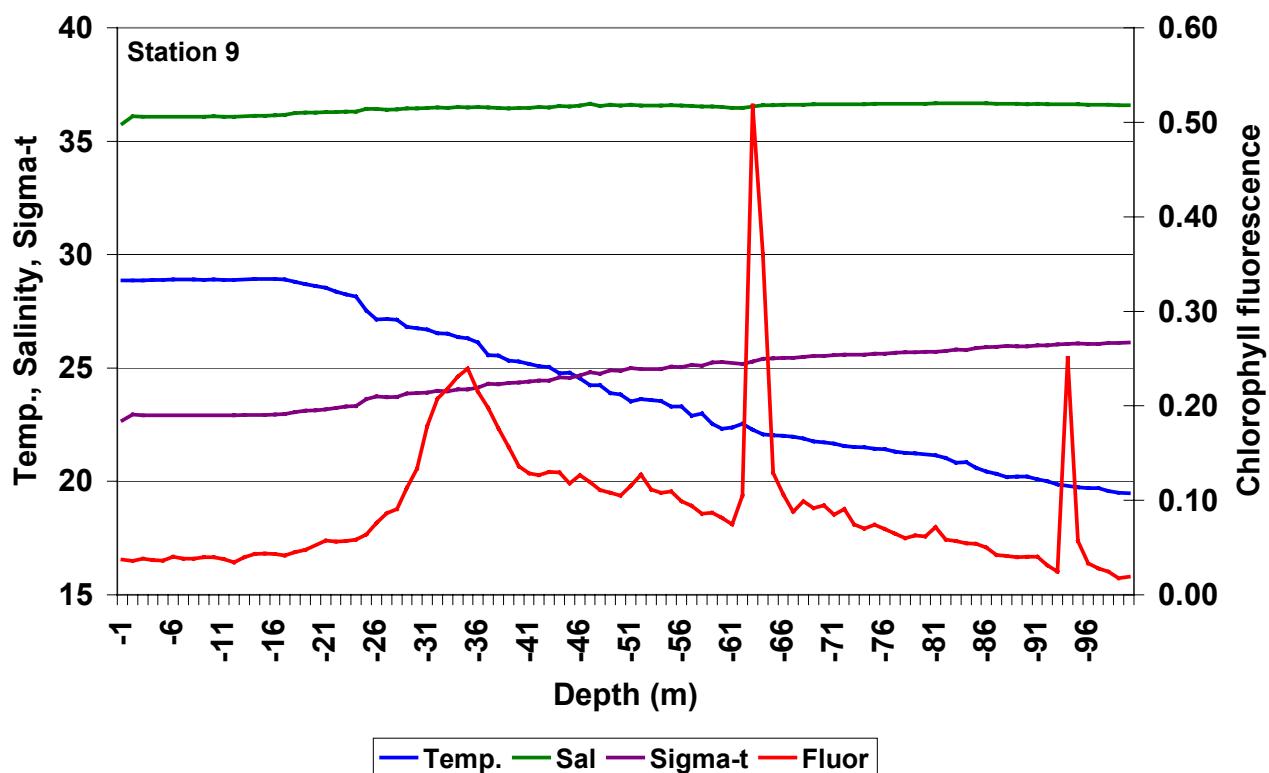
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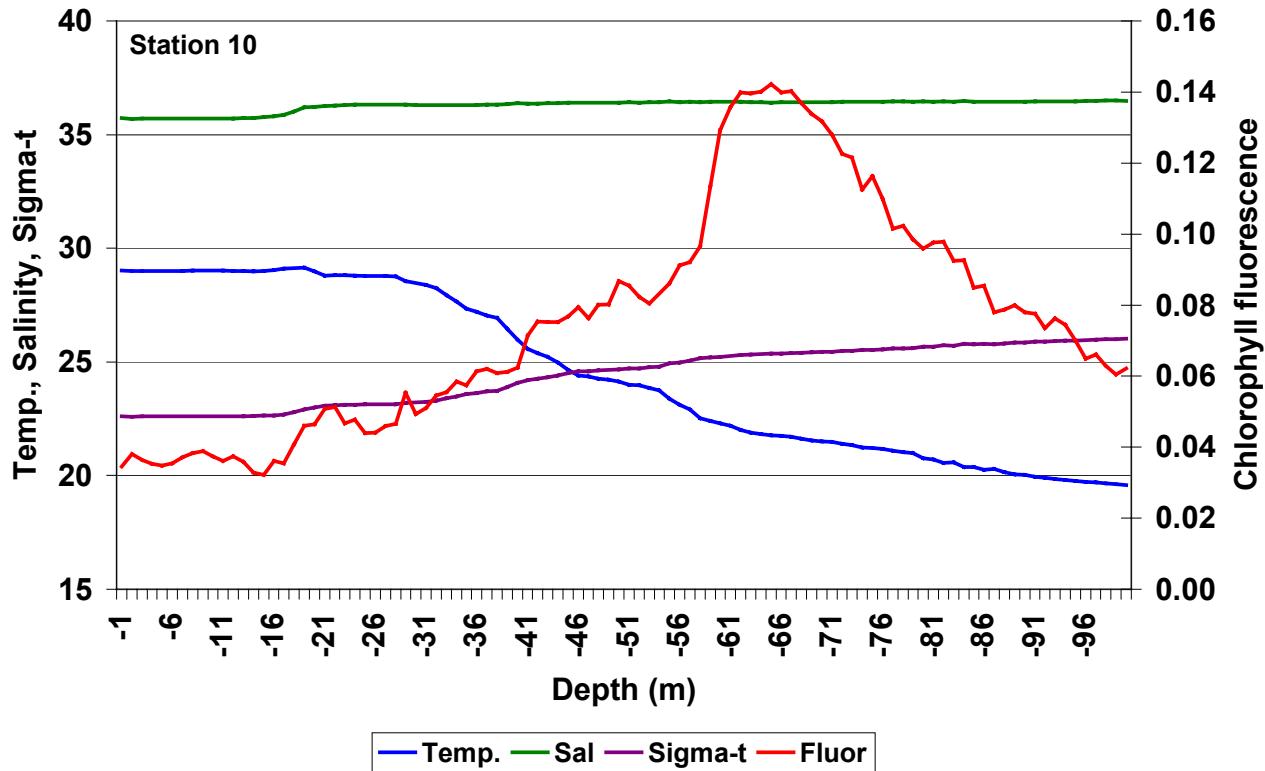
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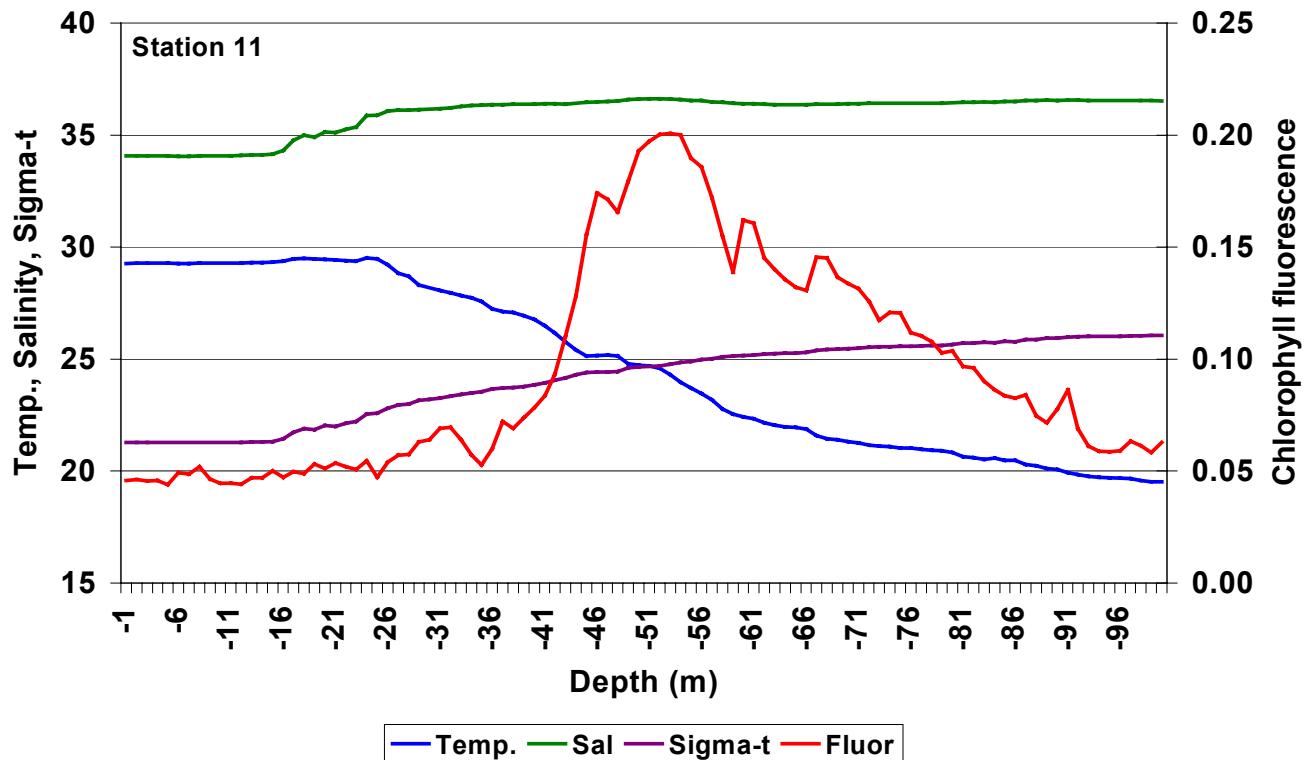
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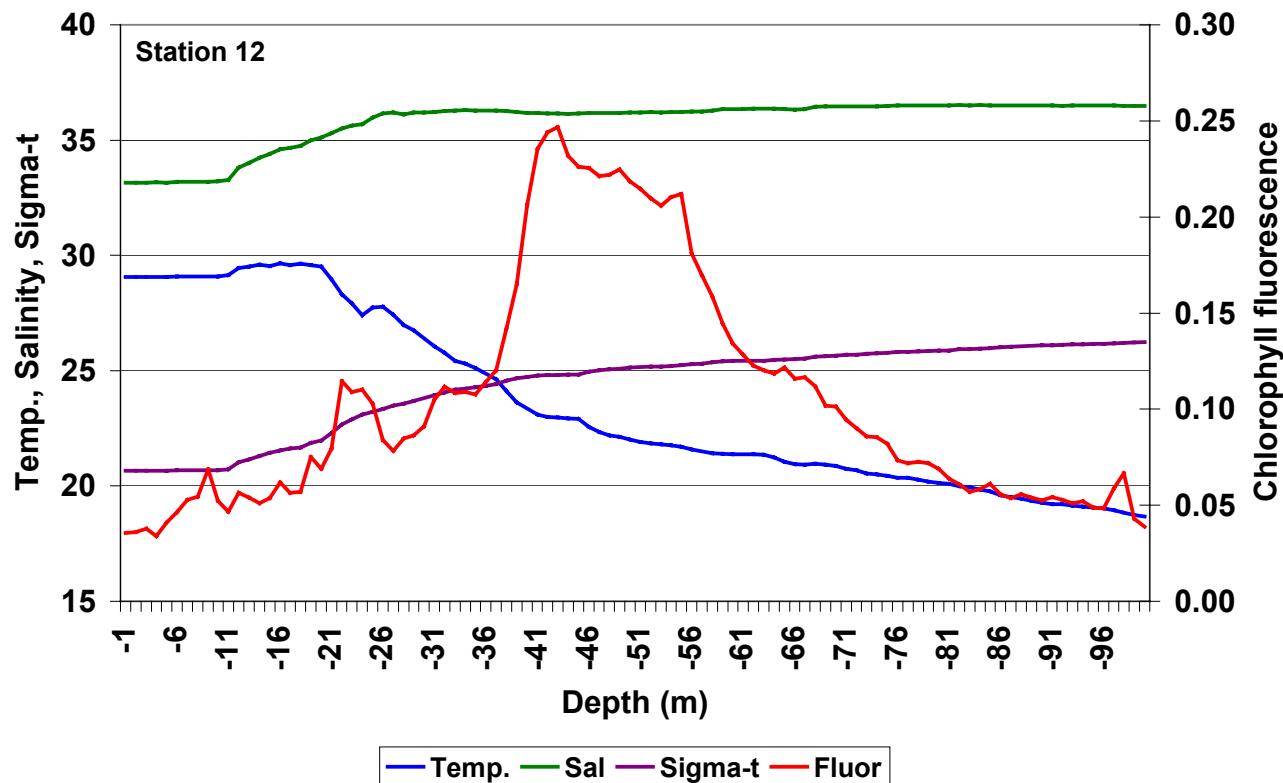
Piney Point Discharge:Sept. 3 to 5



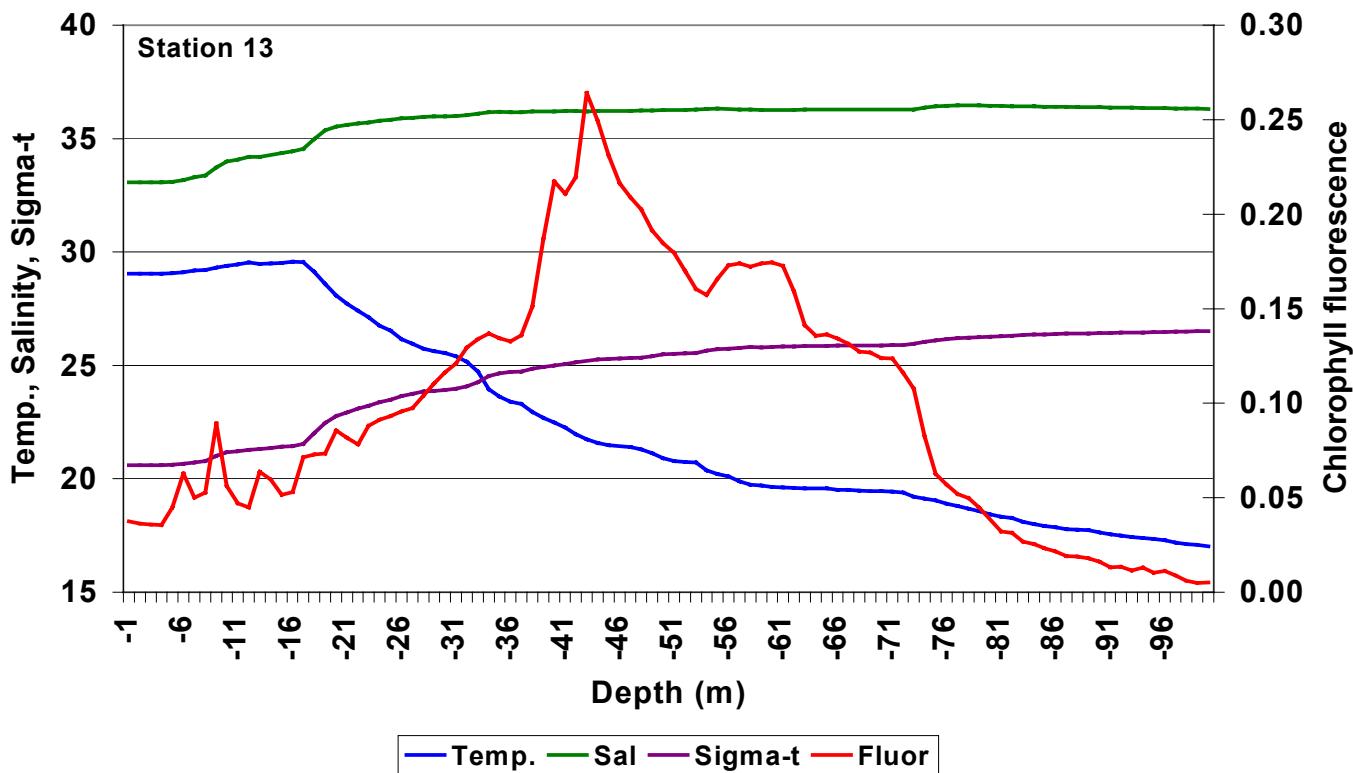
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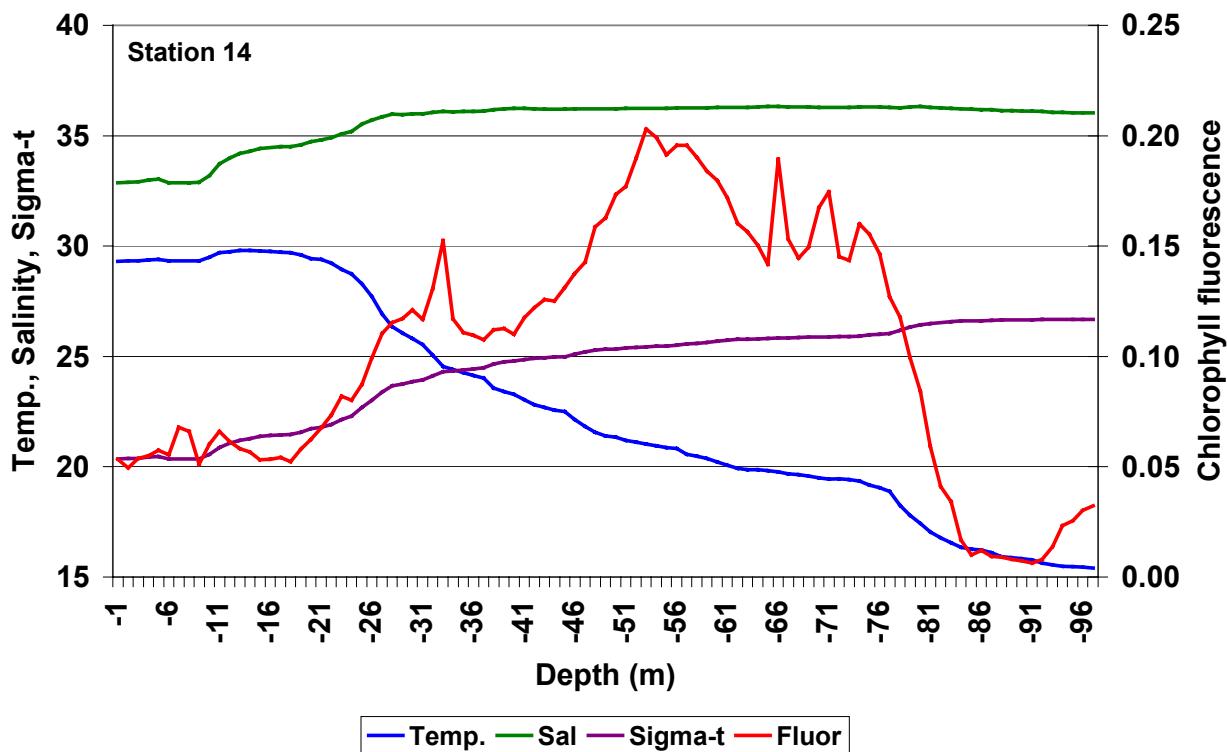
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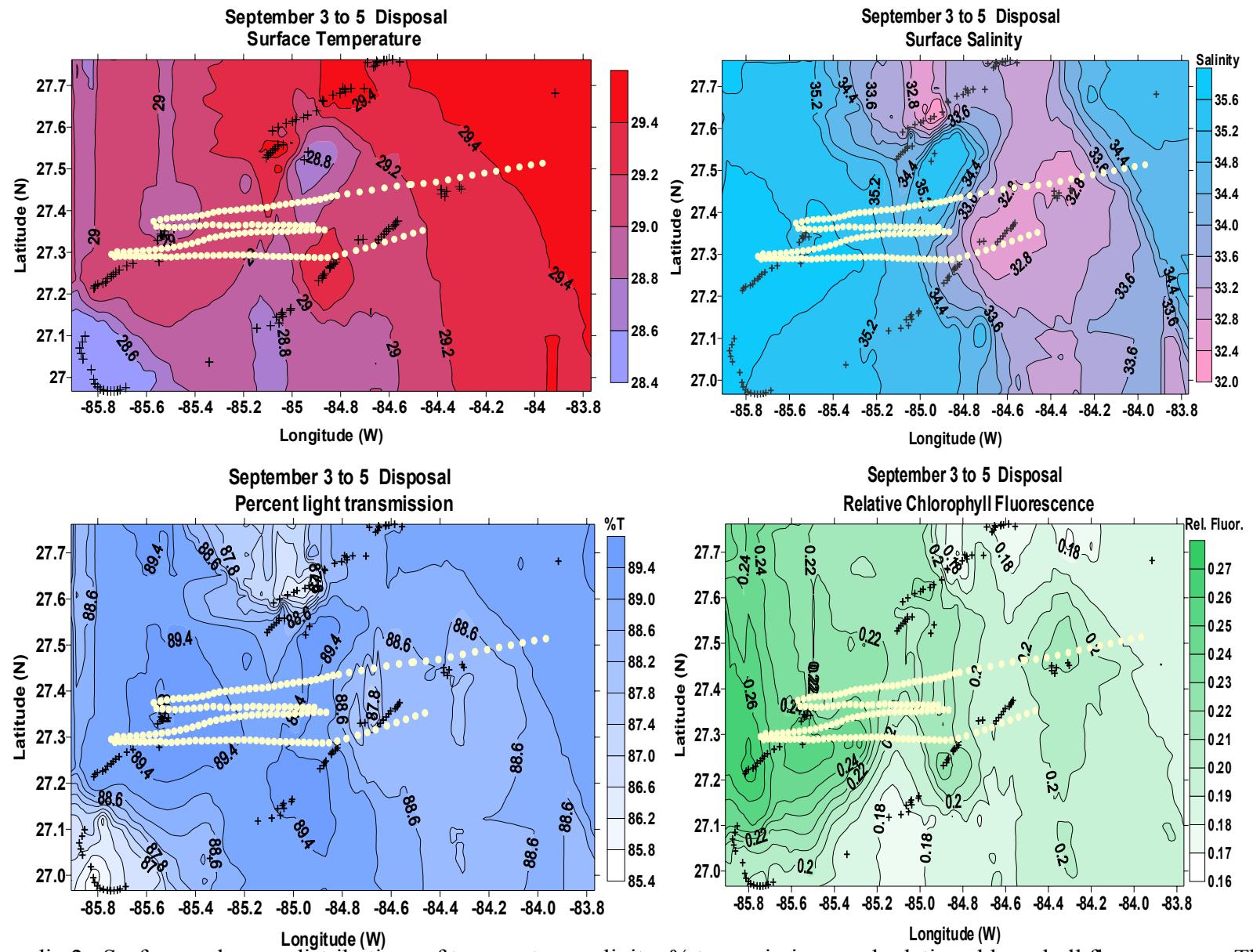


Piney Point Discharge: Sept 3 to 5



Piney Point Discharge: Sept. 3 to 5





Appendix 2: Surface underway distributions of temperature, salinity, % transmission , and relative chlorophyll fluorescence. The monitoring cruise track is marked by the (+) symbol and the barge discharge track by the solid yellow dots.

Appendix 3
Piney Point Discharge Survey
September 3 - 5, 2003

Extracted Chlorophyll-a concentrations

Date	Latitude	Longitude	Station	Depth	CHL ug/L	Avg CHL ug/L	Phaeo ug/L	Avg PH ug/L	Comments
9/3/2003	27 45.693	-84 29.085	1	0	0.18	0.19	0.08	0.07	
9/3/2003	27 45.693	-84 29.085	1	0	0.20	0.06			2 small trichomes & 1 small Puff
9/3/2003	27 45.693	-84 29.085	1	10	0.19	0.25	0.06	0.12	1 small trichome
9/3/2003	27 45.693	-84 29.085	1	10	0.32	0.17			2 trichomes and 3 small trichomes
9/3/2003	27 45.693	-84 29.085	1	50	0.28	0.36	0.25	0.41	Subsurface CHL Max
9/3/2003	27 45.693	-84 29.085	1	50	0.45		0.57		Subsurface CHL Max
9/3/2003	27 41.526	-84 39.414	2	0	0.24	0.22	0.09	0.08	1 trichome
9/3/2003	27 41.526	-84 39.414	2	0	0.20		0.07		1 small trichome
9/3/2003	27 41.526	-84 39.414	2	10	0.18	0.18	0.06	0.05	1 small Puff
9/3/2003	27 41.526	-84 39.414	2	10	0.18		0.04		
9/3/2003	27 41.526	-84 39.414	2	45	0.48	0.49	0.43	0.44	Subsurface CHL Max
9/3/2003	27 41.526	-84 39.414	2	45	0.50		0.45		Subsurface CHL Max
9/3/2003	27 32.489	-84 49.642	3	0	0.19	0.18	0.06	0.06	2 small trichomes
9/3/2003	27 32.489	-84 49.642	3	0	0.18		0.06		
9/3/2003	27 32.489	-84 49.642	3	10	0.19	0.20	0.07	0.07	
9/3/2003	27 32.489	-84 49.642	3	10	0.20		0.06		1 small trichome
9/3/2003	27 32.489	-84 49.642	3	45	0.58	0.58	0.61	0.63	Subsurface CHL Max
9/3/2003	27 33.054	-84 59.914	4	0	0.16	0.16	0.07	0.07	Subsurface CHL Max/1 small trichome, 1 small Puff
9/3/2003	27 33.054	-84 59.914	4	0	0.16		0.07		
9/3/2003	27 33.054	-84 59.914	4	10	0.18	0.18	0.13	0.14	1 trichome
9/3/2003	27 33.054	-84 59.914	4	10	0.18		0.14		
9/3/2003	27 33.054	-84 59.914	4	60	0.32	0.40	0.62	0.72	Subsurface CHL Max/1 small Puff
9/3/2003	27 33.054	-84 59.914	4	60	0.49		0.83		Subsurface CHL Max
9/4/2003	27 28.752	-85 10.050	5	0	0.12	0.28	0.08	0.12	2 Tufts
9/4/2003	27 28.752	-85 10.050	5	0	0.43		0.16		
9/4/2003	27 28.752	-85 10.050	5	10	0.14	0.13	0.09	0.09	
9/4/2003	27 28.752	-85 10.050	5	10	0.12		0.10		
9/4/2003	27 28.752	-85 10.050	5	50	0.39	0.39	0.74	0.74	Subsurface CHL Max
9/4/2003	27 28.752	-85 10.050	5	50	0.39		0.75		Subsurface CHL Max
9/4/2003	27 19.918	-85 30.353	6	0	0.17	0.17	0.10	0.10	
9/4/2003	27 19.918	-85 30.353	6	0	0.18		0.10		
9/4/2003	27 19.918	-85 30.353	6	10	0.17	0.17	0.13	0.12	
9/4/2003	27 19.918	-85 30.353	6	10	0.17		0.12		
9/4/2003	27 19.918	-85 30.353	6	40	0.44	0.46	0.51	0.53	Subsurface CHL Max
9/4/2003	27 19.918	-85 30.353	6	40	0.48		0.56		Subsurface CHL Max
9/4/2003	27 11.498	-85 50.267	7	0	0.18	0.19	0.12	0.13	1 small Puff
9/4/2003	27 11.498	-85 50.267	7	0	0.20		0.13		
9/4/2003	27 11.498	-85 50.267	7	10	0.20	0.19	0.13	0.13	
9/4/2003	27 11.498	-85 50.267	7	10	0.19		0.13		
9/4/2003	27 11.498	-85 50.267	7	60	0.26	0.27	0.31	0.31	Subsurface CHL Max
9/4/2003	27 11.498	-85 50.267	7	60	0.28		0.31		Subsurface CHL Max
9/4/2003	ND	ND	8	ND	ND	ND	ND	ND	Skipped due to bad weather
9/4/2003	ND	ND	8	ND	ND	ND	ND	ND	Skipped due to bad weather
9/4/2003	ND	ND	8	ND	ND	ND	ND	ND	Skipped due to bad weather
9/4/2003	ND	ND	8	ND	ND	ND	ND	ND	Skipped due to bad weather
9/4/2003	ND	ND	8	ND	ND	ND	ND	ND	Skipped due to bad weather
9/4/2003	27 02.251	-85 20.635	9	0	0.19	0.13	0.12	0.09	1 trichome
9/4/2003	27 02.251	-85 20.635	9	0	0.07		0.05		
9/4/2003	27 02.251	-85 20.635	9	10	0.19	0.20	0.11	0.13	
9/4/2003	27 02.251	-85 20.635	9	10	0.21		0.14		1 Tuff
9/4/2003	27 02.251	-85 20.635	9	35	0.44	0.44	0.48	0.46	Subsurface CHL Max
9/4/2003	27 02.251	-85 20.635	9	35	0.44		0.44		Subsurface CHL Max
9/4/2003	27 10.967	-85 00.423	10	0	0.23	0.20	0.11	0.12	1 trichome
9/4/2003	27 10.967	-85 00.423	10	0	0.17		0.12		
9/4/2003	27 10.967	-85 00.423	10	10	0.17	0.17	0.12	0.11	
9/4/2003	27 10.967	-85 00.423	10	10	0.17		0.10		
9/4/2003	27 10.967	-85 00.423	10	65	0.27	0.25	0.64	0.64	Subsurface CHL Max
9/4/2003	27 10.967	-85 00.423	10	65	0.23		0.63		Subsurface CHL Max
9/4/2003	27 15.294	-84 50.223	11	0	0.31	0.25	0.15	0.10	1 Puff
9/4/2003	27 15.294	-84 50.223	11	0	0.19		0.05		
9/4/2003	27 15.294	-84 50.223	11	10	0.23	0.21	0.08	0.07	1 trichome
9/4/2003	27 15.294	-84 50.223	11	10	0.20		0.05		
9/4/2003	27 15.294	-84 50.223	11	50	0.41	0.42	0.63	0.69	Subsurface CHL Max
9/4/2003	27 15.294	-84 50.223	11	50	0.42		0.75		Subsurface CHL Max
9/4/2003	27 19.669	-84 40.055	12	0	0.21	0.22	0.06	0.07	1 trichome
9/4/2003	27 19.669	-84 40.055	12	10	0.22		0.08		
9/4/2003	27 19.669	-84 40.055	12	10	0.21		0.09		1 small trichome
9/4/2003	27 19.669	-84 40.055	12	40	0.56	0.56	0.65	0.65	Subsurface CHL Max
9/4/2003	27 19.669	-84 40.055	12	40	0.55		0.64		Subsurface CHL Max
9/4/2003	27 24.155	-84 29.887	13	0	0.24	0.31	0.09	0.12	1 trichome
9/4/2003	27 24.155	-84 29.887	13	0	0.37		0.16		2 Tufts, 1 Puff, 1 trichome
9/4/2003	27 24.155	-84 29.887	13	10	0.24	0.22	0.09	0.08	
9/4/2003	27 24.155	-84 29.887	13	10	0.20		0.08		
9/4/2003	27 24.155	-84 29.887	13	40	0.52	0.55	0.67	0.65	Subsurface CHL Max
9/4/2003	27 24.155	-84 29.887	13	40	0.58		0.63		Subsurface CHL Max
9/4/2003	27 28.533	-84 20.109	14	0	0.28	0.27	0.09	0.10	1 Tuff
9/4/2003	27 28.533	-84 20.109	14	0	0.25		0.10		1 small Puff
9/4/2003	27 28.533	-84 20.109	14	10	0.23	0.22	0.14	0.13	
9/4/2003	27 28.533	-84 20.109	14	10	0.21		0.12		
9/4/2003	27 28.533	-84 20.109	14	55	0.37	0.38	0.65	0.64	Subsurface CHL Max
9/4/2003	27 28.533	-84 20.109	14	55	0.40		0.62		Subsurface CHL Max
Fractioned CHL									
9/3/2003	27 45.693	-84 29.085	1	0	0.20	100.00	0.06	86.00	>5 um fraction - 1 trichome
9/3/2003	27 45.693	-84 29.085	1	0	0.00		0.01	14.00	< 5 um >GF/F filter fraction
9/3/2003	27 33.054	-84 59.914	4	10	0.16	89.00	0.08	57.00	>5 um fraction - 1 small Puff
9/3/2003	27 33.054	-84 59.914	4	10	0.00		0.01	7.00	< 5 um >GF/F filter fraction - 1 small Puff
9/4/2003	27 11.498	-85 00.423	7	60	0.28	100.00	0.30	97.00	>5 um filter fraction
9/4/2003	27 11.498	-85 00.423	7	60	0.00		0.01	3.00	< 5 um > GF/F filter fraction
9/4/2003	27 02.251	-85 20.635	9	0	0.16	100.00	0.10	100+	>5 um filter fraction - 1 Tuff, 5 trichomes
9/4/2003	27 02.251	-85 20.635	9	0	0.00		0.01	11.00	< 5 um >GF/F filter fraction
9/4/2003	27 15.294	-84 50.223	11	10	0.17	81.00	0.08	100+	>5 um filter fraction - 1 Tuff
9/4/2003	27 15.294	-84 50.223	11	10	0.00		0.00	< 5 um >G/F/F filter fraction	
9/4/2003	27 24.155	-84 29.887	13	40	0.55	100.00	0.56	86.00	> 5 um filter fraction
9/4/2003	27 24.155	-84 29.887	13	40	0.00		0.01	2.00	< 5 um >GF/F filter fraction